LOW-CARBON AFRICA: GHANA

POVERTY

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1. COUNTRY CONTEXT

1.1 Overview of the Energy Sector

Ghana's energy sector is characterized by huge dominance of traditional biomass resources. In terms of endowment and utilization, biomass (mainly woodfuels – firewood and charcoal – and to a lesser extent crop residue) is the most important primary energy resource in Ghana accounting for an average of 81 per cent of primary energy[1] and 76 per cent of final energy[2] consumed in Ghana between 2000 and 2008. Petroleum accounts for 12 per cent of primary energy supply and 17 per cent of final energy consumed while the share of electricity in the national energy mix is assessed at between 6 per cent and 7 per cent over the same period.

However, the energy balance of Ghana is likely to be altered significantly following the discovery and commercial production of hydrocarbons in Ghana since late 2010.

Woodfuel (charcoal, firewood and crop/sawmill residue) is the main source of cooking fuel for up to 85 per cent of households in Ghana as indicated in Figure 1. The use of LPG as a cooking fuel is prevalent in less than 10 per cent of all households with all others fuels (electricity, kerosene) being used by less than 1 per cent of households in Ghana for cooking. The bulk of woodfuels (up to 90 per cent) consumed in Ghana is obtained from standing tree stocks with the rest coming from sawmill residues. With no dedicated woodlots or concerted afforestation/reforestation programmes in place, the countries woodfuel resources has dwindled at a very alarming rate of 3 per cent per annum creating difficulties for households who now have to travel over long distances to collect firewood for cooking and for sale.

Approximately 67 per cent of all Ghanaians have access to grid electricity compared to a sub-Saharan average of 22 per cent and a West African average of around

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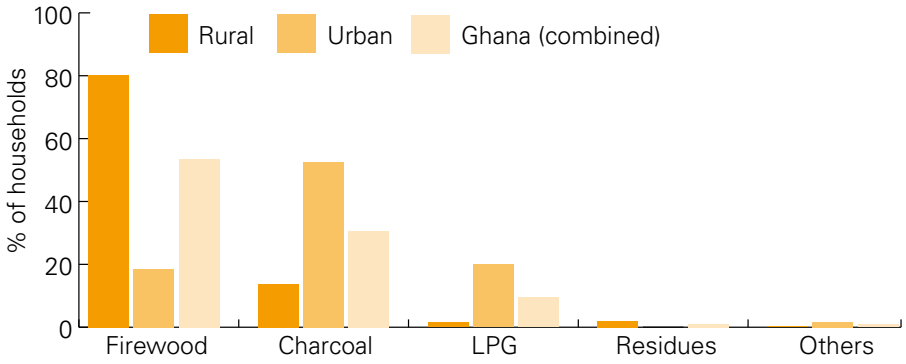
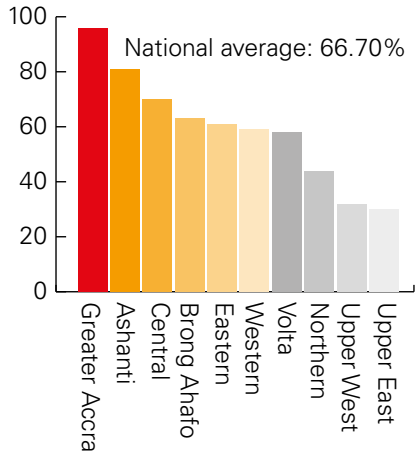
Figure 1. Sources of Cooking Fuels in Ghana by Locality



18 per cent. Per capita electricity consumption is estimated at 460kWh based on 2010 consumption. However electrification is very much an urban phenomenon with as high as 78 per cent of urban inhabitants having access to electricity compared to less than 30 per cent of their rural counterparts. The Greater Accra region has the highest electrification level of 96 per cent while the Upper East Region is the least electrified (30 per cent) as indicated in Figure 2.

Figure 2. Regional Access to Electricity in Ghana



Electricity is produced from two main sources – hydro and thermal with a total installed capacity of 2,011MW. Historically, Ghana has depended largely on hydroelectric power. Two hydroelectric plants, located at Akosombo (1,020 MW) and Kpong (160 MW) on the Volta River are responsible for up to 60 per cent of installed generation capacity. The remaining 40 per cent of installed capacity i.e. 831MW is produced from 5 thermal plants located at Aboadze, near Takoradi and Tema.

However, thermal generation is projected to exceed hydro generation over the next decade with the majority of planned capacity additions expected to come from thermal sources. Peak electricity demand has been growing at a rate of 1.4 per cent annually, from 1,258 MW in 2000 to 1,547 MW in 2010 while total electricity consumption has been growing at an annual rate of 3.3 per cent from 7,539 GWh to 10,305 GWh during the same period (PSEC, 2010). Figure 3 shows the share of electric system load by sectors in 2009.

Figure 3. Electricity Consumption by Sector (2009)

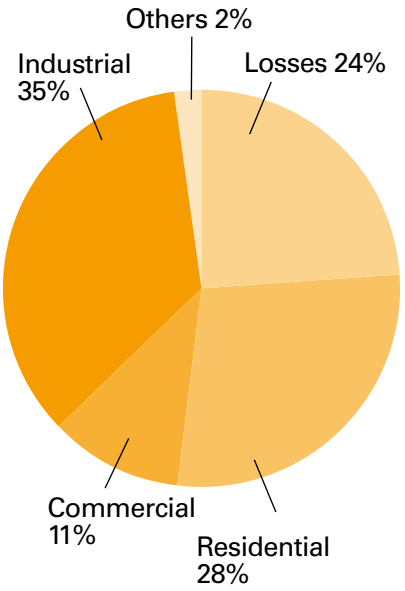


Figure 3 shows, inter alia, that Ghana Electricity Supply Industry (ESI) is characterised by high total system losses (transmission and distribution) of up to 24 per cent. Another characteristic feature of the ESI is frequent unplanned outages estimated to average 10 hours per month for various categories of customers, which translates to around 120 GWh of lost load in 2009.

It has been estimated that power system reliability failures are costing the Ghanaian economy a whopping amount of between US US$320 and US US$924 million (excluding a number of indirect costs) or between 2 per cent and 6 per cent of GDP every year with the industrial sector estimated to be losing US US$598 million each year as result of erratic power supply in Ghana (PSEC, 2010). The Association of Ghana Industries (AGI) has recently been calling on the electric utilities and the industry regulator to ensure improvement in system reliability since frequent unannounced outages were costing the members of the association several millions of dollars.

Ghana is endowed with a range of renewable energy resources. Table 1 provides a summary of the renewable energy potentials of Ghana.

Table 1 shows that the renewable energy potential of Ghana is huge yet remains largely unutilised. This is something the GOG recognizes and has consequently put in place a number of policy and regulatory measures to help scale up the uptake and utilization of renewable energy in the national energy mix. One of such key measures is the setting of a target of 10 per cent for new renewable energy systems (excluding large hydro and woodfuels) in electricity generation mix by 2020 and the formulation of a Renewable Energy Bill, which is currently before the Ghanaian Parliament and is expected to be passed into law by the end of 2011. To help create the necessary enabling environment for a private sector-led development and promotion of renewable technologies in Ghana,

Table 1: Summary of Renewable Energy Potentials of Ghana

Resource	Resource Potential	Current Status
Solar	Daily solar irradiation levels between 4-6 kWh/m^2 and annual sunshine duration ranging between 1800 and 3000 hours.	Over 6000 solar stand alone home systems mainly for electrification in off-grid regions with installed capacity of 3.2MW have been installed. This is relatively small compared to the huge potential of the country.
Wind	The wind energy potential has been estimated to be 5,600 MW with wind speeds of over 6m/s at 50m found along the coastal belt of Ghana.	Power generation from wind has largely been untapped.
Hydro	Potential exploitable hydro resource for Ghana is estimated to be 2,500 MW.	1,180MW is used already for large hydro power generation at Akosombo and Kpong dams. The construction of the 400 MW Bui hydroelectric power project is currently underway. The remaining 840MW of resource can be obtained from 21 sites mainly for medium and small hydro power plants with capacities between 95MW and 17MW hydropower potentials.
Bioenergy	An estimated 18 million metric tonnes of woodfuel is produced every year from the natural forest while the climatic and soil conditions are suitable for large-scale cultivation of early-maturing tree species. In addition to the woody biomass potential of Ghana, the country generates huge volumes of crop and animal residue that could be converted into electrical and/heat energy.	Apart from traditional uses of biomass, the modern bioenergy potential of Ghana remains largely unutilized. However, some biomass-fired co-generated projects have been implemented in the oil-palm industry with installed capacity of 1,954kW with an average annual production of 7.0 GWh

Source: Ministry of Energy, Renewable Energy Directorate, 2010

the GOG is currently implementing the Electricity Access and Renewable Energy (EARE) project as a key component of the Ghana Energy Development and Access Programme (GEDAP). The key aspects and the current status of the EARE are presented in Section 3.2.

1.2 Energy and Climate Resilience and Adaptation

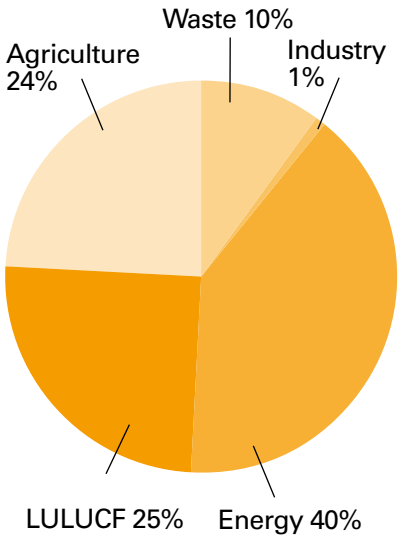
The heavy reliance of Ghana's energy system/sector on hydroelectric power and biomass energy makes it less resilient to the impact of climate change. Over the past two decades or so, Ghana has experienced about three major power crises due to poor hydrology in the Volta Lake caused by climate-induced droughts. To increase the adaptive capacity of the electricity system to climate variability, Ghana decided to diversify her energy portfolio by going into thermal power complementation. Unfortunately, high prices of crude oil coupled with the undue delay of the West African Gas Pipeline (WAGP) projects has contrived to limit the availability and capacity utilization factors of the country's thermal power facilities. The commencement of the flow of gas from the WAGP and commercialization of associated gas from the Jubilee oil field is likely to enhance the plant availability and utilization factor. However, the fact that the share of hydroelectric power in the energy balance remains high and hydro continues to provide the base load make the energy sector still very susceptible to climate change. There is therefore the need for the adaptive capacity of energy sector to be increased.

1.3 Ghana and Low Carbon Development Strategy

Low Carbon Development Strategy (LCDS) is a new development paradigm that seeks to promote development while keeping GHG emissions low, or lower. Historically, Ghana has been a low-emitter of GHGs, emitting an estimated 24 mega-tonnes of CO2-equivalent in 2006[3] (the equivalent of approximately 1.1 CO2 per capita) and until the mid-1990s even a carbon sink, with carbon absorbed by the country forest (EPA, 2010). However, as result of a growing population and economy coupled with unsustainable utilization of the forest resources, Ghana's GHG emissions have increased significantly turning Ghana recently into a net-emitter of GHGs. Energy, Land Use, Land Use Change and Forestry (LULUCF) and Agriculture are the most important sources of GHG emissions as indicated in Figure 4.

GHG emissions are expected to grow in tandem with economic

Figure 4. GHG Emissions by Sector in Ghana (2006)



growth, development and increasing population. The energy sector is projected to continue as the fastest growing contributor of emissions because the sector is confronted with growing demand, while new plants are likely to be fossil fuel-based. Although, Ghana's contribution to global GHG emissions is infinitesimal and thus could be justified if she adopts a nonchalant attitude towards climate change, her reliance on climate sensitive sectors such as agriculture, forestry and energy production makes the country particularly vulnerable to climate change and variability.

Already, the country is reeling under the effects of the global phenomenon with evidence abounding to show that Ghana's coastal zone, agriculture and water resources as well as poverty, health and livelihoods have all been impacted negatively by climate change. Indeed more than 80 per cent of disasters (flooding, droughts, pest, disease outbreaks, extreme weather events, etc) in Ghana are believed to be caused by climate-related impacts (MEST, 2010)[4] . It is therefore in Ghana's supreme interest not to tread a business-as-usual high carbon development pathway while pursuing economic growth and socio-economic development.

Besides, Ghana recognizes that looking at development through a low carbon lens could be beneficial in itself since that can bring about significant short and long-term development benefits to the nation. In the short-term, low carbon growth interventions are expected to bring to the fore direct business opportunities and cost reductions, as well as opening access to international funding through mechanisms such as REDD+ and other climate-related financing schemes while in the long-term the interventions are expected to create a more robust economy, better able to withstand shocks and stresses and resulting in the creation of a more equitable and integrated society (MEST, 2010).

Although Ghana does not have a comprehensive LCDS document (in the strict sense of the definition of LCDS concept) in place as yet, there have been a number of isolated climate-related efforts and initiatives that have been implemented since the 1990s, for various reasons but ultimately leading to low carbon outcomes. These interventions are mainly in the areas of energy efficiency and renewable energy technologies, some of which are discussed in the case studies that follow in Section 3.

Meanwhile, Ghana has since 2010 initiated a process towards formulating a comprehensive national climate change policy dubbed the National Climate Change Policy Framework (NCCPF). The aim of the NCCPF is to ensure a climate resilient and climate compatible economy while achieving sustainable development and equitable low carbon economic growth for Ghana. The NCCPF seeks to achieve three main objectives: low carbon growth; effective adaptation to climate change; and social development and the realization of these objectives is expected to be built around the following systemic pillars: governance and coordination; capacity building; research and knowledge management; finance; international corporation; communication; and monitoring and reporting.

In November 2010, the National Climate Change Committee (NCCC) under the auspices of the Ministry of Environment Science and Technology (MEST) produced a discussion document entitled Ghana Goes for Green Growth (GGFGG), which, inter alia, explores what climate change means for Ghana, and what is needed to address low carbon growth, adaptation and social dimensions of climate change. The GGFGG does not prescribe priorities for sectors, regions, technologies or instruments, but is intended to kick-start a national dialogue among key stakeholders that will lead to general consensus on what needs to be done to achieve green growth for Ghana. A series of stakeholder consultative workshops are currently being organized to elicit stakeholder inputs and feedback towards finalizing the NCCPF by the end of 2011.

1.4 Barriers to Low Carbon Development

The pursuit of climate compatible development in Ghana, especially interventions in the energy sector, has been hampered by a number of barriers in the areas of policy, regulation and financing. Lack of access to appropriate and affordable financing mechanisms to, among other things, help bridge the gap between low carbon solutions and their commercial viability as well as remove high upfront cost, is arguably the most inhibiting hurdle that has stifled the uptake of cleaner energy and energy efficient technologies in Ghana. Renewable energy project developers and end-users have over the years found it extremely difficult to raise funds from local financial institutions to undertake investments in low carbon technologies and this has been a major bane in Ghana. Other barriers include relatively low level of awareness and capacity constraints both in project development and regulation.

2. CASE STUDIES

2.1 Improved Charcoal Cookstoves Project

Charcoal is the main cooking fuel for approximately 1.3 million households (31 per cent) in Ghana. Fifty-three per cent of urban and 14 per cent of rural households depend on charcoal to meet their cooking energy needs. However, charcoal production has been singled out as a major cause of forest degradation and deforestation in Ghana because charcoal is typically produced from inefficient kilns (traditional earth mound kilns with efficiency of 18 per cent in weight terms) with a typical carbonization ratio of 8:1 (about 8 tonnes of wood to 1 tonne of charcoal). Charcoal is in addition consumed in an equally inefficient traditional charcoal cooking device known as 'Coal pot'.

The recognition that improved cookstoves can lead to significant reduction in the utilisation of woodfuel has inspired the promotion of various forms of improved cookstoves in Ghana since the late 1980s. The first major effort to promote improved cookstoves in the country dates back to 1989 when the then Ministry of Mines and Energy developed, tested and disseminated the 'Ahibenso' stove. The 'Ahibenso' stove has a conversion efficiency of between 30-39 per cent and is reputed to save about 35-40 per cent of charcoal over the traditional coal pot. Dissemination of the stove started in 1992 and an estimated 30,000 plus pieces of stove are known to have been produced from a centralised factory by trained artisans and sold to residents of Accra and the other regional capitals (MoEN, 1998). Although few stoves still exist in the market in Accra, the promotion and production have not been sustained as commercialization and access to producer finance was not ensured after Government support ended. Also, the artisan version of the stove did not live up to the industrialized version promoted on TV and other media and was not adopted by the potential consumers (CARE, 2009).

In 2002, EnterpriseWorks/VITA (EWV) started promoting a Kenyan sourced alternative cookstove (Kenya Ceramic Jico-Stove) called Gyapa (meaning 'good fire') stove under the Energy for Household Cooking Project with funding from USAID and the Shell Foundation. The project focused on the manufacture and commercialization of consumer-oriented designed stoves that reduce Indoor Air Pollution (IAP), use less fuel, last longer and are safer than traditional stoves.

The Gyapa is made up of a metal cladding with a wide base and a ceramic liner. The ceramic liner provides improved insulation, hence higher efficiency of up 50 per cent over the traditional coal pot, a hotter flame and improved combustion. The stove can also be regulated and it is clean since ash is retained in the lower part of the stove. The Gyapa stove has a project lifespan of 3-5 years. However, the ceramic liner is due for replacement every 2 years.

The stoves are sold at retail price of between US US$9 and US US$12 (CARE, 2009). To create a robust supply chain, EWV trained local metal workers to manufacture the Gyapa and then linked them with local retail outlets. Local ceramists were also trained to produce the stove's ceramic liner. Since stove manufacture and distribution began, EWV Ghana has sold over 150,000 stoves and has mentored manufacturers, distributors and retailers that are currently operating on a self-sustaining basis.

Two of EWV mentees are Messrs Suraj Wahab and Ernest Kyei of the 2011 Ashden Award winning Toyola Energy Limited (TEL) fame who were part of the 78 artisans trained by EWV in technical stove manufacturing skills at a USAID workshop in 2002. The two entrepreneurs have since gone ahead to established one of the most successful and sustainable charcoal cookstove businesses in the world.

The TEL world-acclaimed success story began in 2006 when they established a Stove Business with the assistance of Kumasi Institute of Technology and Environment (KITE), under the African Rural Energy Enterprise Development (AREED) programme. KITE advised and helped TEL to develop a business plan, which was approved for funding by the AREED Investment Committee leading to the release of TEL's initial loan facility of US US$70,000. TEL has subsequently received two more loan facilities of US US$100,000 each from E+Co bringing to US US$270,000 total loan advanced to TEL payable in 5 years.

TEL is implementing an innovative business model that involves the poor along the whole value chain as suppliers, manufacturers, retailers and customers. The company has trained about 300 artisans who are each encouraged to specialize in the production of one of the stove's 26 constituent parts. This specialization is believed to have led to a 6-fold increase in productivity of the artisans. TEL buys the metal frames for the cookstoves from scrap metal dealers. The company also pre-finances orders from local artisans for the other components of the stove such as the handles and lids. The ceramic liners are manufactured at a central facility in the Eastern region of Ghana supervised by a certified ceramist and then supplied to TEL. The various components of the cookstoves are then assembled by a group of artisans who are specialised in assembling the stoves. TEL has five production centres in Ghana and one in Togo.

TEL often sells its products, priced at US US$7, on credit to local market vendors who earn a 10 per cent commission on each product sold. In some cases, TEL also sells directly on credit to end-users to be paid back over a two month

period using the money saved on charcoal, with many stashing their 'savings' in a 'Toyola Money Box'. In some cases, the company does business on barter basis to give the most deprived segments of the rural population the opportunity to acquire its products. A total of 154,000 stoves have so far been sold providing meals for approximately 1 million Ghanaians. TEL hopes to produce 140,000 more stoves from new bases in Ghana, Benin, Sierra Leone and Nigeria by 2013.

2.1.2 Development Benefits and Impacts

The improved cookstoves projects have resulted in a number of quantifiable developmental benefits which are likely to translate into positive long-term impacts on livelihoods and environment. Some of the observed and assessed benefits are as summarized in Table 2.

There is a huge opportunity for the improved cookstoves projects to be replicated and scaled-up. This is because only 23 per cent of the potential charcoal cookstoves market has been reached, not to mention the equally huge improved firewood cookstoves market that remains practically unserved.

2.2 The Ghana Energy Development and Access Project (GEDAP)

2.2.1 Background

In 1989, the Government of Ghana (GOG) launched, what was then thought to be an ambitious programme, to achieve universal access to electricity (100 per cent electrification from a modest level of 23 per cent at the inception of the programme) over a period of three decades (1990-2020). The National Electrification Scheme (NES) and the Self-Help Electrification Programme (SHEP) are the two main vehicles being used by the GOG to extend the reach of electricity to every Ghanaian. After 20 years of implementation, approximately 67 per cent of all households in Ghana (over 80 per cent urban and 27 per cent rural) have access to electricity.

In spite of the bold policy decision and political will of successive governments to achieve universal access through grid extensions, governments over the years have been realistic enough to concede that it would be absolutely impracticable and prohibitively expensive to attempt to connect every single community in Ghana to the national grid and have therefore been looking at other off-grid renewable energy-based solutions to

Table 2: Benefits and Impact of Improved Cookstoves in Ghana

Benefit Type	Potential or observed benefits/impacts
ECONOMIC	• TEL is expected to make a profit of US US$33,000 after loan repayment in 5 years • Reduction in fuel cost by a magnitude of between 40-50% is expected to translate into increase in disposable income for poor households • Over 300 jobs already created under the Gyapa stove project (expected to grow by 20% as production and sale grow over the next 3 years); another 200+ school leavers employed by TEL • Extra revenues received by TEL through carbon offsets purchased by Goldman Sachs • The sale and use of 240,000 Gyapa stoves is expected to help reduce CO2 by 1.2 million tonnes over 7 years and save up 1.4 million tonnes of wood that would have been used for charcoal production
ENVIRONMENTAL	• The Toyola stove is projected to reduce charcoal use by 26,000 tonnes per year, thereby saving trees and cutting CO2 emissions by 150,000 tonnes. • Reduced deforestations and forest degradation
SOCIAL	• Reduction in Indoor Air Pollution (IAP)
OTHERS	• Human and institutional capacities built through business development component of project • Technological self-reliance

Source: Authors' Construct

Table 3: Off-Grid Solar Projects in Ghana

Project	Key Outputs	Cost and Funding Source	Implementing Agency
Off-grid PV Rural Electrification Project (Commenced in 1998 and covered 10 villages)	• 1,923 SHS installed • 14 hospitals equipped with vaccine refrigerators and solar lighting • 200 solar streetlights • 48 schools and community centres electrified with solar PV • 2 water pumping and irrigation systems • 6 battery charging centres • 1 grid connected system • Total installed capacity of 261,600 kWp	• US US$5 million • 50% concessionary loan & 50% official export credit from Spanish Government	• Ministry of Energy • Isofoton SA of Spain • Wilkins Engineering (Local Partner)
Renewable Energy Service Project (RESPRO) (1999-2001)	• 288 households provided with SHS in 13 communities in Northern Ghana	• US US$3.072 million • 80% from UNDP; 16% from GOG and 4% from DOE/NREL	• Ministry of Energy • RESPRO – a special purpose agency set up by MoE
Renewable Energy Development Project (REDP) (2000-2002)	• 11 new RE Service Centres (RESCs) established • 3 old RESCs rehabilitated • 300 customers provided with PV systems • 3 health centres provided with lighting and vaccine refrigerators • 6 schools equipped with lighting • Seed Funds set in 6 Rural Banks	• 8 million Danish Kroner (US US$4.1million) • DANIDA	• Ministry of Energy

Source: Authors' Construct, 2011

provide the unserved and unservable communities with access to modern electric energy services. Three major largely donor-funded off-grid renewable energy projects have been implemented since 1998 as summarized in Table 3.

All the three initiatives were pilot and/or demonstration projects and the lessons learned have been incorporated into the design of the Electricity Access and Renewable Energy Component of the ongoing Ghana Energy Development and Access Project (GEDAP), which is the subject of our second case study.

The GEDAP is a US US$227.5 million multi-donor project involving the World Bank's International Development Association (IDA), Global Energy Facility (GEF), African Development Bank (AfDB), Global Partnership on Output-Based AID (GPOBA), Africa Catalytic Growth Fund (ACGF) and the Swiss Agency for Development and Cooperation (SECO). The budget breakdown and partners contributions are as shown in Table 4.

The development objective of the project is 'to improve the operational efficiency of the electricity distribution system and increase the population's access to electricity, and to help transition Ghana to a low-carbon economy through the reduction of greenhouse gas emissions'. The project has 3 main components: A) sector

Table 4: Breakdown of Funding Sources for the GEDAP

Component	Total Cost (US US$m)	GoG	ECG	IDA	SECO	GEF	AfDB	ACGF	GPOBA
Sector & Inst. Dev	13.95	1.2		6.0	6.0	.75			
Distribution Improvement	119.9		20.7	40.5			43.7	15.0	
Electric Access & Renewable Energy	92.6			42.5	6.0	4.75		35.0	4.35
PPF	1.0			1.0					

Source: World Bank, 2009

and institutional development; B) electricity distribution; and C) electricity access and renewable energy. The GEDAP was approved by the IDA Board on July 26, 2007, and was declared effective on December 6, 2007, with an original closing date of November 30, 2012, which has been extended to November 2013.

The Electricity Access and Renewable Energy (EARE) component seeks to assist the GOG to establish an enabling environment and facilitate market development to attract private investments in large-scale commercialization of renewable energy and energy efficiency improvement. The EARE has 4 components: 1) renewable energy policy framework and renewable energy/energy efficiency (RE/EE) capacity building; 2) large scale grid-connected renewable energy; 3) mini-grid renewable energy and Energy Service Companies (ESCOs); and 4) stand alone renewable energy systems. The EARE component is to be financed at a cost of US$162.5 million by the GEF (US$5.5m); IDA-GEDAP (US$15m); IFC/IDA MSME project (US$8m) and private sector/banks (US$134m). A summary of the details of each of the components are as indicated in Table 5.

These EARE components are yet to be implemented and therefore various combinations of technology to be used in remote off-grid applications are yet to be identified. However in the absence of local manufacturing RET companies, these technologies are estimated to be imported for the various initiatives under the EARE component of the GEDAP project.

The following are some of the achievements of EARE as of December 2010:

- 106 remote health facilities have been provided with solar systems
- Procurement process for solar systems in additional health facilities and remote teachers' quarters underway
- Contract awarded for socio-economic study for island communities on the Volta river
- Off-grid electricity with PV systems successfully launched in 11 villages
- 104 solar photovoltaic large systems, 263 solar PV small systems and 1,060 solar lanterns installed/supplied
- Operational manual for matching grants business development services modified to include RE business
- Fund manager procured
- Capacity building for rural banks and solar companies on-going

(Source: GEDAP Project Coordination Unit, Ministry of Energy, 2011)

2.2.2 Development Benefits and Impacts

The project is expected to provide populations in hitherto unserved communities with increased access to adequate, reliable, clean and efficient energy services. The electrical energy so made available will facilitate the establishment of income generating activities that can help create jobs and reduce poverty as well as enhancing the provision of vital social services such as water supply, healthcare, education, etc. By seeking to create the enabling environment and devising appropriate financing mechanisms, the project is expected to help attract greater private participation in the RE/EE sector. The project will also empower the communities, cooperatives, local financing institutions and MFIs, to operate and replicate these schemes on their own. It is expected that emerging business models from implementation of this project will serve as templates to design and implement RE/EE projects nationwide. In addition, the project is expected to mitigate an estimated 8 million tonnes of CO2 throughout the life of project equipment thereby helping to transition Ghana into a low-carbon economy.

Table 5: Summary of the EARE Component of the GEDAP

Sub-Component	Objective	Activities	Expected Outputs/ Outcomes
1.Renewable Energy Policy Framework and Capacity Building *(Total Cost: US$11m – GEF US$1m; IDA US$10m)*	To remove policy, capacity, and information barriers to accelerated grid-connected and off-grid RE	• Develop RE legal, policy and regulatory framework • Coordinate grid vs. off-grid electrification • Build capacities and increase awareness of key stakeholders • Conduct resource assessments and disseminate information to private developers	• Number of RE policy, legal and regulatory frameworks developed • Number of RE stakeholder capacity built
2.Large-Scale Grid-Connected RE *(Total Cost: US$121m – GEF 1m; private sector and commercial banks US$120m)*	To remove policy, capacity and financing barriers to accelerated large-scale grid-connected RE systems	• Assist GOG to develop bidding package for pipeline RE projects • Hire technical and financial advisors to provide transaction to GOG to negotiate pilot projects	• 1-2 pilot large-scale grid connected RE projects with installed capacity of 50MW developed
3.Mini-grid RE and ESCOs *(Total Cost: US$21.6million – GEF US$1.6m; IDA US$3m; IFC US$8m; private sector US$4m; local commercial banks US$6m)*	To remove capacity and financing barriers to accelerate small-scale grid connected mini-grid RE below 10 MW as well as establish ESCOs	• Provide business support to both local RE developers, ESCOs, and commercial banks • IDA refinancing via local banks for on-lending to RE developers and co-financing support to ESCOs on a long-term basis	• 2 small hydro projects with installed capacity of 3 MW • 8-10 village hydro projects with total installed capacity of 5 kW • 3-5 biomass cogeneration plants with total installed capacity of 5 MW • 1-2 pilot wind farm (3-5 MW capacity) • 5 ESCOs
4.Standalone RE systems *(Total Cost: US$8.6million – GEF US$1.6m; IDA US$3m; rural banks US$4m)*	Remove technical, awareness, market, and financing barriers to accelerate standalone RE systems with capacities of between 500w and 2kW.	• Build capacity of Apex bank and participating banks • Support solar industry association to conduct marketing and awareness campaigns and provide training • Provide incentive to dealers to build a wide network across country • Provide IDA refinancing to rural banks who can then provide long-term credit to consumers	• 15,000 solar PV systems with installed capacity of between 450kW • 500 small-scale wind systems with installed capacity of 500kW

Source: GEF, 2005

2.3 National Implementation of CFL Exchange Programme

2.3.1 Background

Demand-Side Management (DSM) refers generally to energy efficiency measures that modify or reduce end-users' energy demand. Traditionally, DSM is seen as a means of reducing peak electricity demand so that utilities can delay building new additional capacity. By reducing the overall load on an electricity network, DSM can result in various beneficial effects, including mitigating electrical system emergencies, reducing the number of blackouts and increasing system reliability. Other possible benefits can also include reducing dependency on expensive imports of fuel, reducing energy prices, and reducing harmful emissions to the environment. DSM measures may be classified into 3 main categories: 1) energy reduction programme – actively or passively reducing demand through more efficient processes, buildings or equipment; 2) load management programme – changing load pattern and encouraging less demand at peak times and peak rates; and 3) load growth and conservation programmes.

The use of DSM as an energy planning tool in Ghana was formally introduced by the Volta River Authority (VRA) in the early 1990s. In a bid to reduce electricity demand in the residential sector, which typically accounts for more than 50 per cent of peak load (with lighting load responsible for more than 70 per cent of electricity consumed in sector), the VRA conducted a study to assess the impact of lighting retrofitting on peak demand in 1994. The study concluded that providing electricity consumers with Compact Fluorescent Lamps (CFLs) to replace incandescent bulbs was very beneficial even if the CFLs were to be given out for free. The VRA therefore imported up to US US$1 million worth of CFLs to be sold at highly subsidized rate using the customer service points of the distribution utilities – the Electricity Company of Ghana (ECG) and the Northern Electricity Department (NED) – as sales outlets.

For various reasons such as, low electricity tariffs (which gave consumers little incentives to be energy efficient), lack of consumer awareness of the benefits associated with switching to CFLs, poor marketing strategy adopted by ECG and poor quality of the lamps, the initial introduction of CFLs received little patronage. Furthermore, the subsidised lamps were smuggled out of the country by purchasers to neighbouring Cote d'Ivoire where there was more consumer awareness of the CFL saving and where electricity tariffs also gave consumers a sufficient incentive to conserve energy. The market for CFLs has however changed significantly since the initial experimentation by VRA following a comprehensive DSM programme introduced by the GOG and implemented by the Energy Foundation as part of the ongoing Power Sector Reform process. The reform has, inter alia, led to significant and sustained increases in electricity tariffs, which when combined with increased awareness on the benefits of CFLs and other policy measures has led to a thriving private-sector led CFL market in Ghana.

It is estimated that the use of CFLs in households increased from 20 per cent in 2007 to 79 per cent compared to the use of incandescent bulbs which dropped from 58 per cent to 3 per cent during the same period. However, the increased penetration of CFLs is attributable largely to a massive CFL distribution programme embarked upon by the GOG in 2007, which is the subject of our next case study. Currently there is ban on the importation of incandescent lamps effective January, 2011.

In 2007, Ghana experienced her worst power crisis since 1998. The power crisis which was caused by poor hydrology in the Volta Lake and lasted for up to 12 months led to far-reaching power rationing regime whereby all categories of electricity consumer went without electricity for at least 12 hours every other day. As part of the measures to address power shortage, the GOG imported six million CFLs of various wattages at a cost of US US$13 million and distributed them free of charge to households throughout Ghana under a public exchange programme, which included the disposal of incandescent filament lamps.

CFL is by far the quickest, cheapest and easiest technology that can be used to improve energy efficiency in the residential sector. Relative to other energy saving products, CFLs are affordable and offer competitive energy savings and shorter payback periods, making them an easy way to achieve energy savings. The CFLs, which were imported from China, were installed in households in every district throughout Ghana. The Ministry of Energy and the Energy Commission engaged task forces who were trained to go from house to house, remove and replace every incandescent bulb in the house with CFLs and return the incandescent bulb to a central place where they were destroyed.

2.3.2 Development Benefits and Impacts

The CFL Exchange programme brought a number of benefits to households and country at large. At the national level, the intervention led to a 124MW reduction in maximum demand of energy and energy savings in excess of US US$38 million per annum (assuming an oil price of US US$120 bbl). When compared to the 126 MW Emergency Thermal Power Plant installed in the heat of the power crisis at the cost of US US$105 million, the CFL programme was clearly a cheaper (8 times) way of dealing with the energy crisis. The programme also had significant environmental benefits in the form of reduced emissions assessed at 105,000 tonnes of CO2 per annum. Consumers also benefited in terms

of reduction in their energy demand with a corresponding reduction in energy bill. It terms of impacts, the programme (coupled with the subsequent ban on incandescent) has led to a lasting paradigm shift in consumer choice of lighting products in that CFL is now the preferred and most widely used lighting product within residential households in Ghana. There are however risks associated with the CFL programme some of which are summarized below.

- The government's decision to flood the CFL market with bulbs at no cost undermined private businesses dealing in the bulbs.
- After having received their first set of bulbs for free, there is the risk that some households will return to inefficient lamps after the bulbs get burned.
- The influx of low-quality CFL on the market has in the past created problems for the promoters of CFLs. It is important for strict quality standards to be enforced to ensure that consumers do not lose faith in the products.
- CFLs contain a relatively small amount of mercury so it has to be handled well when the bulbs are burnt out to avoid possible mercury poisoning.

3. LEAPFROG POTENTIAL

Lack of access to affordable investment funds is arguably the biggest challenge facing the development and commercialization of low-carbon energy projects in Ghana. With bank lending rates typically in the range of 25-35 per cent and usually available only on short to medium term durations, proponents and developers of carbon compatible initiatives are unable to raise funding at the local level. It is no wonder that the majority of very interesting project ideas with significant developmental benefits still remain on the drawing board.

The fact that the majority of successful and promising case studies rely almost exclusively on grants and concessionary credits goes to emphasise the need for continued availability of such financing schemes. It goes without saying that the TELs who are now being celebrated globally may never have emerged as successful clean energy businesses but for the AREED programme that provided them with enterprise development services as well as soft loans (seed capital). It would have been almost impossible for any local bank (including the multinationals like Barclays and Standard Chartered banks) to have granted a loan of up US US$270,000 at a rate of 5-6 per cent per annum to a virtually unknown SME. Apart from investment capital, access to end-user financing (in the form of micro-finance) is also a big challenge in Ghana.

A leapfrog fund made accessible on affordable terms will undoubtedly give the development and commercialization of low-carbon energy projects targeted at poverty reduction a big shot in the arm. Such a fund should be designed to provide support throughout the entire business development cycle in the form of investment loans and micro-finance schemes. The cost of capital and of doing business still remains high and does not look to be coming down anytime soon. It is therefore imperative that a LFF should be so structured to buy down the cost of borrowing before private sector capital could be leveraged to support the low-carbon development agenda of the country.

A LFF can typically be expected to address the financial constraints to pursuing a low-carbon development pathway. It is therefore important for other complementary policy and regulatory measures to be put in place to address other barriers such as constraints to technology transfer, as a result of barriers to foreign direct investment, limited capacity to adopt and learn from new technologies, intellectual property rights, or behavioural inertia, etc; informational constraints relating to technology availability and associated benefits and costs, including uncertainty about future energy prices; capacity constraints across sectors to identify and develop low-carbon alternatives; and institutional constraints relating to slow development of markets. The NCCPF being developed could be targeted and the necessary provisions made to address all these constraints.

The private sector has a key role to play in plugging financing gaps that will inevitably exist even with the establishment of a LFF. However, to be able to attract the much-needed private capital, investors would first look to see whether the investment environment is ideal and safe enough before venturing into any business. The GEDAP project is seeking to create the enabling environment policy and regulatory environment that would help attract private capital. It remains to be seen the extent to which the GEDAP can succeed in doing this.

3.1 Conclusions

Low carbon development has emerged as a way to address the dual challenge of increasing energy supply that are critical for economic growth for all developing countries and reducing GHG emissions and managing climate change. The transition to low carbon growth path requires significant amounts of investment. However, investment finance required for low carbon development is well beyond the domestic purse of the country and so far funding available for climate change mitigation has gone to large-scale projects in middle-income countries. Therefore it is important for least developed countries such as Ghana to find innovative ways to finance clean energy projects if they are to leapfrog over unsustainable energy that contributes to climate change.

The Government recognises the opportunities that pursuing a low carbon development path presents and has been involved in several low carbon energy interventions. However, these interventions have been fraught with barriers and risks that have locked the country's potential for scaling-up low carbon energy developments.

A number of conclusions can be drawn from the review of case studies in Ghana. These include:

- Low carbon developments hold important development co-benefits: clean energy technologies present important opportunities to improve standards of living, reduce environmental pollution and degradation and allows the poor communities to participate in climate change mitigation
- The provision of adequate finance to scale-up low carbon investments: the lack of finance or the difficulty in assessing adequate finance to start-up low carbon projects has not only affected the wide scale deployment of clean energy technologies but it has also hindered the participation of private sector investors in the low carbon development path. The provision of finance would enhance the mix of public and private investors in low carbon energy investments. Soft-

loans could also provide some guarantee for end-users. The provision of grants could help scale-up dissemination activities for clean energy options and address the need for research and development (R&D) to promote energy

- Clear and consistent policy framework to boost market development: clean energy technologies, particularly small-scale enterprises suffer from policy priority and government support. A clear and consistent policy framework would aid in addressing the knowledge, technical and institutional capability gap. This would improve product quality; reduce price and increase promotion and delivery of technologies. Capacity building programme would not only provide opportunities to demonstrate the value of clean energy but also provide orientation on climate change impacts. Government support in the form of subsidies and tax incentives would accelerate the development of these technologies on a large-scale and nationwide.

The proposed LFF by Christian Aid aims at addressing these issues and scaling-up low carbon energy activities in Ghana. Based on the positive development impacts that these activities have had in Ghana so far, the LFF would enable Ghana to achieve significant reductions in GHG and help in its transition to a low carbon economy.

ENDNOTES

1 Primary energy is made up of energy commodities that are either extracted or captured directly from resources such as crude oil, wood fuel.

2 Final energy is the total useful energy supplied to consumers. The total final consumption is the sum of final energy consumption of all fuel types by the end use sectors within the border of the country.

3 It should be noted that the 2006 GHG emissions represents 97 per cent increase in their 2000 levels of 12.2 million CO2-eq.

4 Ministry of Environment, Science and Technology (2010). Ghana Goes for Green Growth – National Engagement on Climate Change. Ministry of Environment, Science and Technology Publication.

LIST OF ACRONYMS

ACGF	Africa Catalytic Growth Fund
AfDB	African Development Bank
AREED	African Rural Energy Enterprise Development
CDM	Clean Development Mechanism
CFL	Compact Fluorescent Lamp
CIF	Climate Investment Funds
COP	Conference of Parties
DSM	Demand-Side Management
EARE	Energy Access and Renewable Energy
ECG	Electricity Company of Ghana
EE	Energy Efficiency
EPA	Environmental Protection Agency
ESCOs	Energy Service Companies
ESI	Electricity Supply Industry
EWV	Enterprise Works/Vita
GDP	Gross Domestic Product
GEDAP	Ghana Energy Development and Access Programme
GEF	Global Environment Facility
GGFGG	Ghana Goes for Green Growth
GHG	Greenhouse Gas
GPOBA	Global Partnership on Output-Based Aid
IAP	Indoor Air Pollution
IDA	International Development Association
LCDS	Low Carbon Development Strategy
LDCs	Least Developed Countries
LFF	Leap Frog Fund
LPG	Liquefied Petroleum Gas
LULUCF	Land Use, Land Use Change and Forestry
MEST	Ministry of Environment Science and Technology
MW	Mega Watts
NCCPF	National Climate Change Policy Framework
NED	Northern Electricity Department
NES	National Electrification Scheme
RE	Renewable Energy
REDD	Reducing Emissions from Deforestation and Forest Degradation
SECO	Swiss Agency for Development Corporation
SHEP	Self-Help Electrification Scheme
TEL	Toyola Energy Limited
TOR	Terms of Reference
USAID	United States Agency for International Development
VRA	Volta River Authority
WAGP	West Africa Gas Pipeline

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